

of metallurgical processes thus becomes of much importance. We record, therefore, with pleasure, the appearance of a manual by Dr. Gore, devoted to electro-metallurgy proper, which is likely to prove of much use in the spread of the theoretical knowledge so requisite for industrial success. The author gives much attention to this portion of the subject, but in view of the claim "that this book is written to supply a want," it is to be regretted that fuller details are not forthcoming as to the practical working of the processes, though such information as is given is well and clearly put. The greater part of it, however, has already appeared elsewhere. In the case of copper, for instance, if the working arrangements are faulty, the mud liberated on the solution of the impure copper may be deposited again on the cathodes; the tank solution, too, may vary in density, and the working become irregular with a consequent irregularity in the character of the metal produced. Here, again, excessive rapidity, fatal to the purity of the product, is very common, the result being that in the majority of instances it is necessary to melt the deposited copper, thus introducing sources of error which it is one of the main objects of the process to avoid. The incidental collection of the gold and silver in copper submitted to such a refining process may occasionally cease to be an incident and become the main object of the process, ores of gold and silver being intentionally added in the previous smelting operations.

The difficulty of obtaining admission to works employing electrolytic refining methods, which the author himself laments, is so great, that it is with all the more regret that we have to call attention to this want of fuller details as to the more recent modifications of working adopted in this country and elsewhere. The text-book is otherwise an excellent one.

The term "electro-metallurgy" has been generally applied in the United Kingdom to all operations in which a metallic deposit is produced by means of electrolysis, however small the scale of production may be. Such a designation of the art is much too broad, and it would be better to limit the use of the term "electro-metallurgy" to those processes which are employed on a large scale for the purpose of extracting or refining metals, as distinguished, that is, from ordinary galvanoplastic methods.

This criticism applies to the "Treatise on Electro-Metallurgy," by Mr. W. G. McMillan, the greater part of which relates to galvanoplastic methods proper. Metallurgical processes, however, are also considered, though but little space is given to them; and a chapter, which might well have been a longer one, is devoted to electrolytic methods of assay.

Dr. Gore, after giving a brief historical sketch of the subject, passes to a consideration of the theory of electrolysis, which is considered at some length, useful tables being also given. The mode of establishing an electrolytic refinery, together with the plant required for this purpose, is next considered, and in addition to an account of the various types of dynamo-electric machines in use for electrolytic purposes, brief descriptions are also given of the various electro-metallurgical processes which have been from time to time proposed.

In Mr. McMillan's treatise, an historical introduction to the subject of electro-metallurgy is given, accompanied

by a theoretical consideration of the question. A chapter is devoted to the "sources of current," and in a series of other chapters the art of electro-plating is described. Another chapter refers to electro-typing, and others relate to the electro-deposition of the various metals and some alloys. Electro-metallurgical processes proper are also considered, together with methods of assay, and a glossary is added of substances commonly employed in electro-metallurgy. Forty-three useful tables are given as addenda, and the printing is clear and distinct.

We can recommend both these manuals, not only to students, but also to those who are interested in the practical application of electrolytic processes.

OUR BOOK SHELF.

Leçons sur l'Électricité professées à l'Institut Électro-Technique Montefiore annexé à l'Université de Liège. Par Eric Gerard. Tome II. (Paris: Gauthier-Villars et Fils, 1890.)

THIS volume completes the work the first part of which has been already noticed in NATURE (vol. xlii. p. 219). In the first volume, the general principles of electricity and magnetism and the theory of dynamo-electric machinery were explained; the volume now before us contains a very clear and full account of the most important industrial applications of electricity. The principal subjects discussed in this volume are: methods of distribution in electric lighting; transformers, and meters; the insulation of electric light cables; electric motors, both with constant and alternating currents; the transmission of power; electric railways and tramways; descriptions of the various kinds of incandescent and arc lamps; photometry; electro-metallurgy, including the deposition of metals from solutions and fused salts; electric welding. All these subjects are clearly explained, and generally illustrated by instructive diagrams and figures; the book is well up to date, and should prove of great service to students of electric technology. The only fault we have to find with it is that it contains no references which would enable the student to consult for himself papers in which the various processes are described more fully than is possible in a text-book of moderate size. This omission, though exceedingly common in French treatises, is one which we think is greatly to be deplored: in the first place, it leaves the student at the mercy of the author, for, if he does not understand the explanations in the text-book, he does not know where to turn for another with which he might have a better fate; and secondly, we hold that the habit of consulting papers in the Transactions of learned Societies and scientific journals is a most valuable one for the student to acquire, and that it has no chance of developing unless text-books contain references to such papers.

J. J. T.

Fathers of Biology. By Charles McRae, M.A., F.L.S. (London: Percival and Co., 1890.)

STUDENTS of anatomy and physiology, as the author of this little book points out, are apt to suppose that the facts with which they are now being made familiar have all been established by recent observation and experiment. There could not be a greater mistake. Biology is a science of "venerable antiquity," and the way was prepared for modern discoveries by the labours of many patient and far-seeing investigators. In the present volume Mr. McRae has sought to illustrate this by sketching the biological work of Hippocrates, Aristotle, Galen, Vesalius, and Harvey. He could not have selected five inquirers better suited for his purpose; and within the limits he has allotted to himself he has succeeded admir-

ably in indicating the nature and value of the contribution which each of them made to biological science. He is especially happy in his treatment of the three representatives of ancient research; but the essays on Vesalius and Harvey are also clear, well-arranged, and suggestive. Mr. McRae is not content with second-hand information. He has evidently studied the original sources with care; and the result is that his method of exposition is invariably fresh and interesting. He knows, too, how to connect the results attained in former times with those at which later anatomists and physiologists have arrived. He does not, of course, claim to have exhausted the interest of his subject. But the work he has done, so far as it goes, is sound, and should be of service to many of his readers in helping them to understand the various stages in the development of the scientific conceptions with which he deals.

Through Magic Mirrors. By Arabella B. Buckley. (London: Edward Stanford, 1890.)

THIS volume is intended to form a sequel to the "Fair-Land of Science," and is written with the clearness and brightness which make that book so attractive. The power that Miss Buckley has of interesting young people in the more popular parts of the various sciences cannot be doubted, and is well shown in the present book. A magician is supposed to teach young lads; and the author is thus enabled to bring in different parts of the sciences, and to preserve a continuity throughout.

There are ten chapters, and the following are some of the headings: "The Moon," "Life-History of Lichens and Mosses," "History of a Lava Stream," "An Hour with the Sun," "An Evening with the Stars," "Little Beings from a Miniature Ocean, &c." In the chapters with these headings the uses of the telescope, spectro-scope, camera, microscope, &c., are all mentioned and well explained, and their principles clearly brought out.

The information throughout is up to date, and is taken from the best sources; and the illustrations form a most important addition to the text. The frontispiece is a reproduction of Mr. Isaac Roberts's most exquisite photograph of the great nebula of Orion, taken on February 4, 1889.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.*]

The Proposed South Kensington and Paddington Subway.

ALTHOUGH there can be no question but that any facilities of access to the group of buildings on the ground of the Commissioners of the Exhibition of 1851 will be greatly to the advantage of the public, the objections to the proposed railway raised in your recent article on "Shaking the Foundations of Science" are worthy of most serious consideration, if they are not altogether fatal to the scheme. The alternative route for the line which you suggest, along Queen's Gate, would meet with equal difficulties, much greater expense, and certain opposition in several quarters. There is, however, another solution of the question free from most of the objections to both the others.

Let the existing subway be continued as originally projected as a walking road to a station at the Albert Hall; and let the tramway or railway line be brought across Kensington Gardens from Paddington to meet it there. This will have the desired effect of giving easy access to the Albert Hall and neighbourhood from the north-west of London, as well as a convenient dry covered approach from the South Kensington Station. The cost of this scheme to the promoters of the railway will be far less than if they have to enlarge the present subway so as to make it available for carriages. The convenience to the public will be nearly as great. In the proposed scheme anyone coming by the District

Railway must change carriages at the South Kensington Station; and there are few who, having once alighted, would not as soon take a short walk to the Museums or the Albert Hall through the subway (as was originally designed when this was made) as mount into another carriage. It will be a totally different thing from having (as now) to emerge to the upper surface, and either take a cab or trudge along a wet, dirty, and cold road. It would, in fact, be scarcely a longer walk than is often necessitated along the platforms of some of our existing railway stations.

The walking subway, instead of opposition, may well receive the cordial support of all interested in the "foundations of science," as it will lessen the number of wheels which rattle along the streets above. The marvellous improvement that it made in the state of the streets during its brief period of usefulness, the summer of the Indian and Colonial Exhibition, was apparent to all dwellers in the neighbourhood.

W. H. FLOWER.

Natural History Museum, January 12.

WOULD it not be desirable to prepare a petition to the House of Commons, to be signed exclusively by scientific men, against the proposed South Kensington and Paddington Subway Railway? A copy might lie for signature at the rooms of each of the learned Societies.

ALFRED W. BENNETT.

Chemical Action and the Conservation of Energy.

IN NATURE of December 18, 1890 (p. 165), there appears a paper by Mr. Pickering under the above heading, in which some of the errors of thermo-chemists are exposed. As, on account of the well-known experimental skill of Mr. Pickering in thermo-chemistry, there may be some risk that all the positive statements in this paper may be accepted by students as facts, it is, I think, worth pointing out that some of these statements, although given positively as if they were obvious physical laws, are, to say the least, matters of controversy, whilst others are absolutely erroneous. It would seem as though prolonged calorimetric studies lead the experimenter to regard heat changes as the only factors to be considered in cases of chemical equilibrium, since the same erroneous view of the subject has been taken by Berthelot in his "Law of Maximum Work," by J. Thomsen in a similar "Law," and now by Mr. Pickering in this paper. He concludes:—

"As a consequence of this, it follows that, in any complex system of atoms, where two or more different arrangements are independently possible, and where the various products remain within the sphere of action, and are capable of further interaction, then those products, the formation of which is attended with the greater evolution of heat, will be formed to the exclusion of the others."

It is somewhat curious that by way of clearing the ground for his own views Mr. Pickering demolishes one of the chief arguments of the older school—namely, that an endothermic reaction may occur if it forms part of a cycle of which the final result is an evolution of heat. His illustration of the impossibility of this, by comparison with a stone rolling a short way up a hill by itself in order to have a long roll down on the opposite side, is exceedingly apt. But immediately following this is a statement which must be regarded as incorrect: "No amount of heating can make an endothermic reaction possible so long as it remains endothermic."

I have characterized two statements as erroneous; perhaps I may be allowed to mention the evidence usually accepted as proving this, premising that, since it partially depends on the second law of thermodynamics, and this in its turn depends upon experiment (see J. J. Thomson, "Application of Dynamics to Physics and Chemistry," pp. 4 and 5), no argument against it is valid which deals only with single molecules. The researches of J. W. Gibbs (Trans. Conn. Acad., iii. 108, 343), of Lord Rayleigh (Proc. Roy. Inst., vii. p. 386), of Massieu (*Journ. de Phys.*, vi. p. 216, and of Helmholtz (*Sitz. Akad. Berl.*, February 2, 1882, July 27, 1883, and *Monats. der Berl. Akad.*, May 31, 1883, p. 647; also, Physical Society, Translated Memoirs, vol. i., Part 1), prove conclusively the general principle that the evolution of heat alone is not conclusive as to the possibility of a chemical change taking place in a given direction. The magnitude which does condition this change having been arrived at by different methods, in some cases independently, has received different names; thus it is the "free energy" of Helmholtz, the